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E1F FKC

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(54) Abstract Title

Wellbore positioning system

(57) A wellbore positioning system for enabling the easy positioning of downhole tools comprises a series of spiral guide slots (5) which are formed on the inner surface of casing tubulars (1). A locating tool (7) is run into the wellbore attached to the downhole tool to be positioned such as a whipstock (10). The locating tool carries a spring loaded key (15) on its outer surface which is forced outwards by the spring and engages with the guide slot when they meet. The locating tool subsequently travels down into the wellbore following a spiral path until the key reaches the end of the guide slot. The downhole tool is now in the desired position. Several such guide slots may be located at different depths and rotational positions in the casing string. These different guide slots may have differing widths or profiles so as only to allow the engagement of predetermined keys thereby allowing the desired depth and rotational orientation of the tool to be accurately achieved.

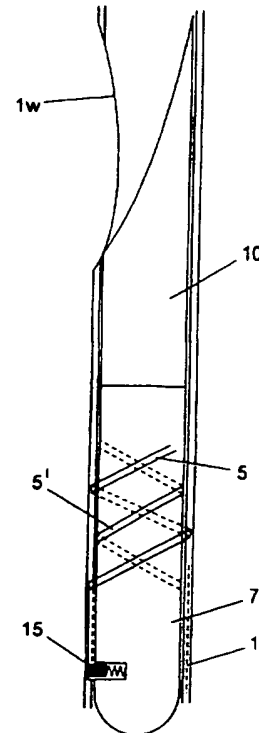


Fig. 4

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This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

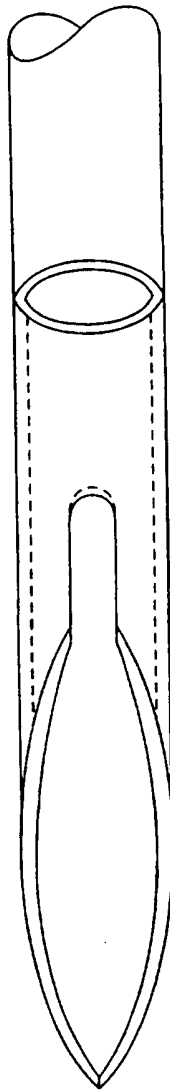


Fig. 1

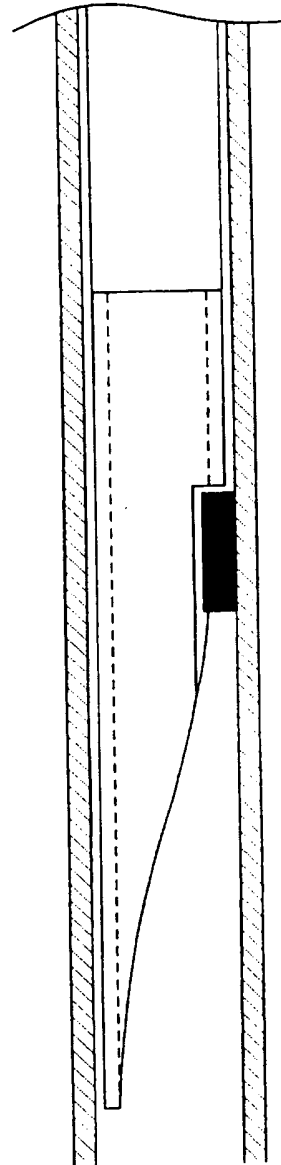


Fig. 1a

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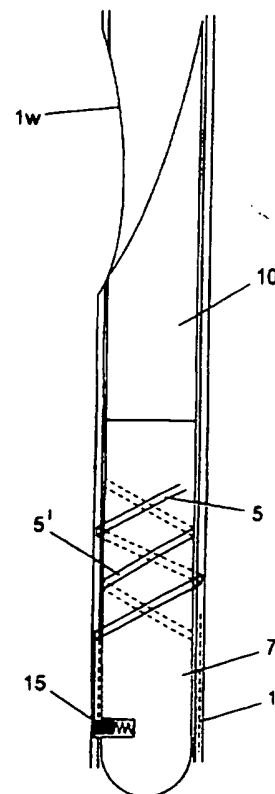


Fig. 4

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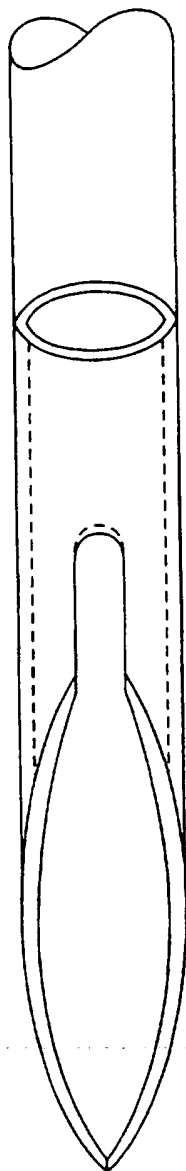


Fig. 1

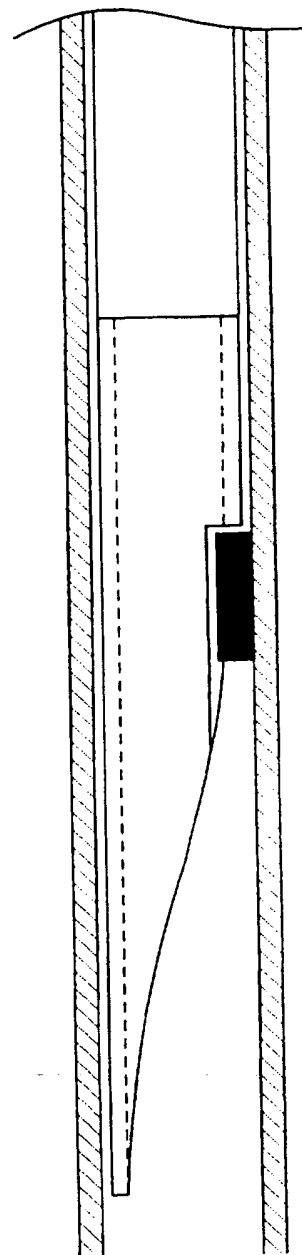


Fig. 1a

2/5

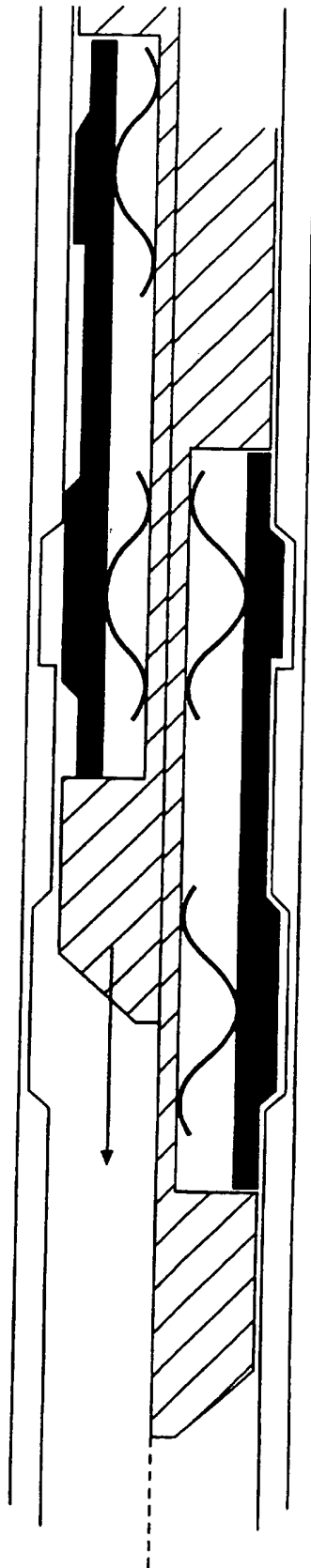


Fig. 2

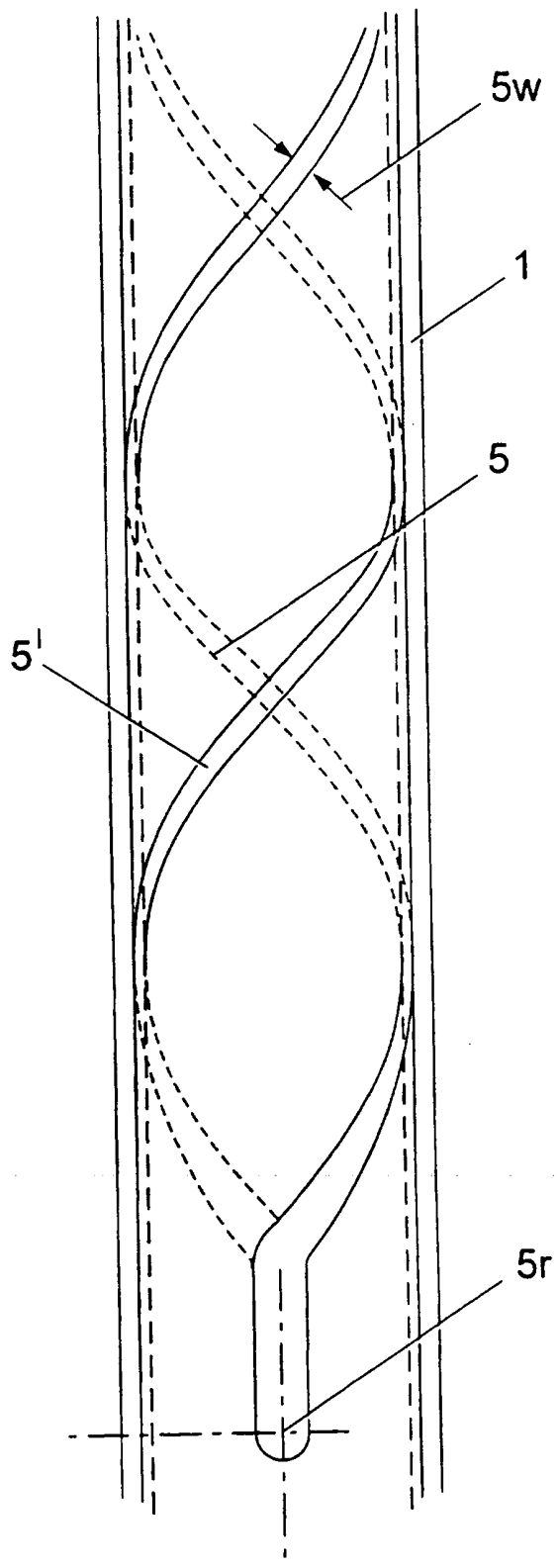


Fig. 3

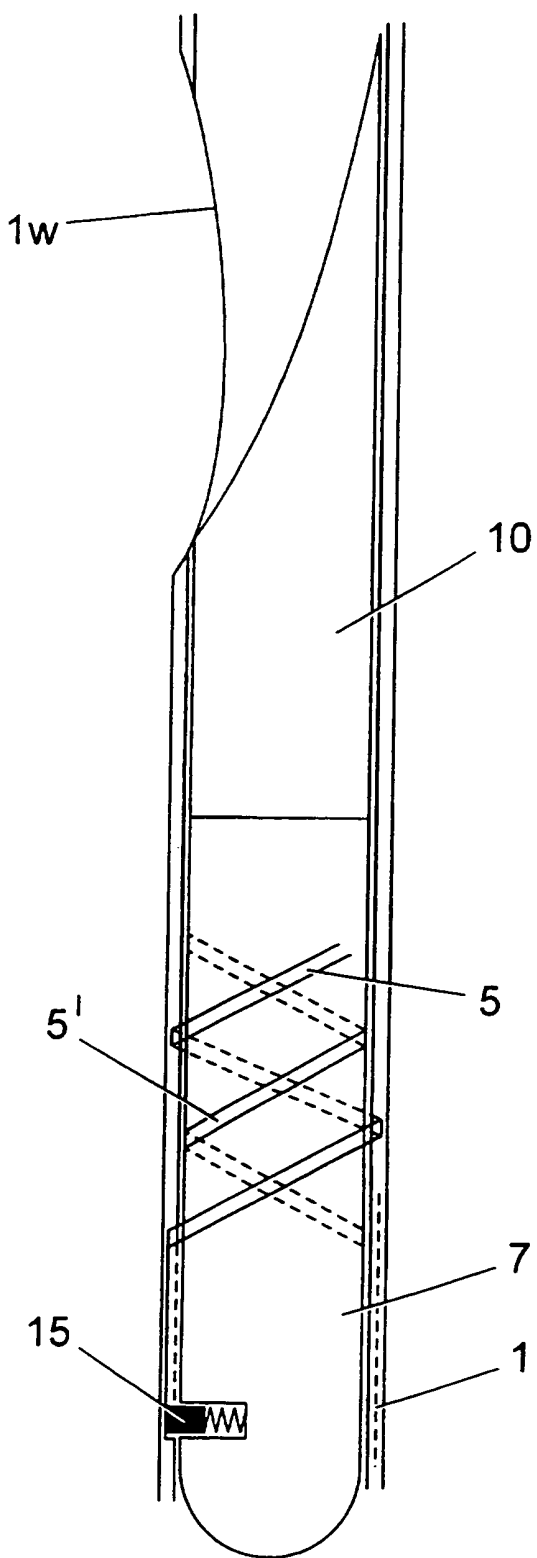


Fig. 4

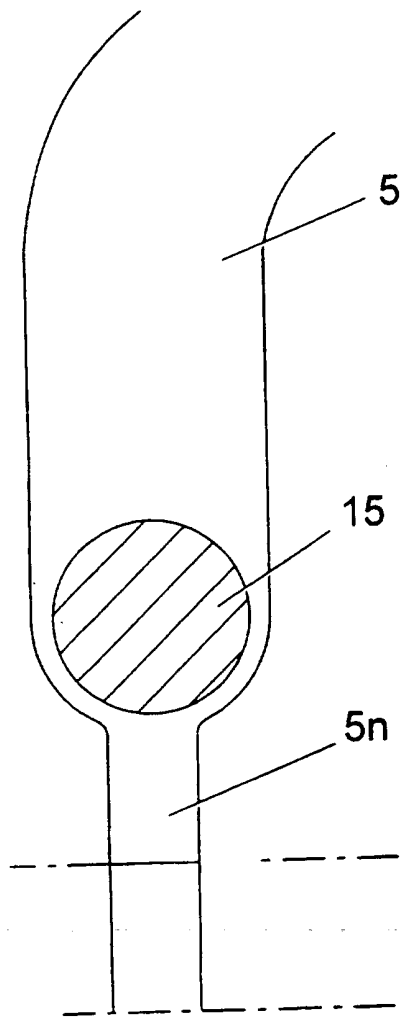


Fig. 5

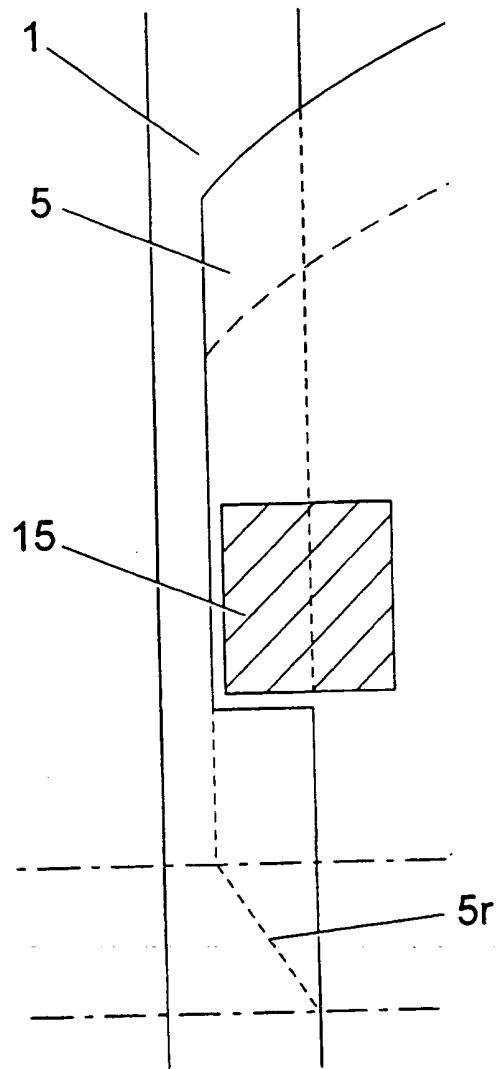


Fig. 5a

1 "Wellbore Positioning System"

2

3 This invention relates to a wellbore positioning system
4 for locating a downhole tool in a borehole.

5

6 A common problem faced when drilling oil wells is how
7 to locate a downhole tool such as a whipstock inside a
8 casing section repeatedly at the same depth and at the
9 same orientation, for example in order to drill a
10 deviated side track through a window in the casing.
11 Several solutions to this problem have been found. The
12 most basic is a muleshoe and key (see Fig. 1) where the
13 key is set inside the casing in a fixed point and a
14 muleshoe profile is machined into the tool being run,
15 or into a separate muleshoe attachment fitted to the
16 string. The muleshoe profile can alternatively be
17 machined into the inner face of the casing (eg upside
18 down with the apex pointing upwards), and a spring
19 loaded key can be provided on the locating tool. In
20 each case, the key comes to rest at a key seat machined
21 into the wall of the muleshoe.

22

23 While the muleshoe allows rotational orientation and
24 depth control of the whipstock or other downhole tool
25 on the string, it does not allow multiple vertical

1 locations to be located automatically. In addition,
2 the key can become snagged on the apex of the muleshoe
3 rather than on the key seat. Also, if the muleshoe is
4 machined into the inner face of the casing, which is
5 preferred, there is a loss of effective diameter, and a
6 consequent weakening in the casing. Furthermore, the
7 key seat can become filled with accumulated debris
8 which can prevent proper seating of the key.

9
10 In an effort to address the problem of identifying
11 multiple vertical locations, location systems such as
12 the selective key setting tool have been devised. In
13 this tool (shown in Fig. 2), a number of locating
14 profiles are machined into the casing, each having a
15 unique shape, and a locating tool with laterally
16 extending spring-loaded keys is run through the casing
17 until the keys match with the desired locating profile,
18 at which point the keys engage the profile and further
19 downward movement is resisted. While this allows the
20 identification of a particular vertical location
21 corresponding to the key, it does not orient the
22 locating tool or whipstock rotationally.

23
24 According to the present invention there is provided a
25 wellbore system for selectively locating a downhole
26 tool in a wellbore casing or tubing comprising a
27 plurality of positioning guides spaced in the wellbore
28 casing or tubing at predetermined depths wherein each
29 positioning guide has a unique profile for selectively
30 receiving a matching profile key of a downhole tool,
31 the guides for each key having a configuration which
32 controls the depth and rotational position of its
33 matching key.

34
35 The control of the vertical and rotational position of
36 the key thereby controls the vertical and rotational

1 position of the member.

2

3 The member can be a downhole assembly such as a running
4 tool or a whipstock etc.

5

6 The invention also provides a method of selectively
7 locating a downhole tool in a wellbore casing or tubing
8 comprising the steps of:

9

- 10 a) placing a plurality of positioning guides at
11 desired depths in the wellbore casing or tubing
12 wherein each guide has a unique profile for
13 selectively receiving a matching profile locating
14 key,
- 15 b) selecting the profile of a locating key for the
16 downhole tool to match the profile of a desired
17 positioning guide, and
- 18 c) running the downhole tool to the desired
19 positioning guide wherein the locating key engages
20 the matching profile of the positioning guide
21 which controls the depth and rotational position
22 of the locating key to orient the downhole tool in
23 a desired direction.

24

25 Preferably each key guide is a slot or a ledge, which
26 in particular embodiments extend downwards and
27 laterally. In a preferred embodiment the key guides
28 are spiral slots, optionally covering a minimum of 450°
29 of circumference.

30

31 By casing, we mean any downhole tubular such as casing,
32 liner, drill pipe, or any functional equivalents.

33

34 It is an important aspect of the invention that each
35 key guide only allows engagement of a particular key,
36 such that the profile of the key only fits within the

1 profile or width of the key guide such as the slot. In
2 particular cases, there can be more than two key
3 guides, and/or more than two keys, so that multiple
4 outlets spaced vertically and rotationally from one
5 another in the casing string can be identified and
6 particular tools in the work string can be located at
7 different rotational positions and at different depths
8 throughout the string.

9
10 In one embodiment, the keys can be spring loaded and/or
11 retractable.

12
13 An embodiment of the present invention will now be
14 described by way of example, and with reference to the
15 accompanying drawings, in which:-

16
17 Fig. 1 shows a muleshoe arrangement of the prior
18 art;

19 Fig. 2 shows a selective key locating system of
20 the prior art;

21 Fig. 3 shows a casing tubular embodying a spiral
22 groove in accordance with one aspect of the
23 invention;

24 Fig. 4 shows a system of the invention being used
25 to instal a whipstock to deflect a drill string
26 through a window in a casing tubular; and

27 Fig. 5 shows the lower part of a groove in the
28 Fig. 4 system.

29
30 Referring now to Figs. 3, 4 and 5, a system in
31 accordance with one embodiment of the invention
32 comprises a casing tubular 1 having spiral grooves 5
33 and 5' machined into its inner face. The grooves 5 and
34 5' are spaced around the inner circumference of the
35 tubular 1 so that they start at opposite sides at 180°
36 spacing. The spiral grooves 5 and 5' extend in a

1 counter-clockwise direction in order to prevent the
2 inadvertent backoff of threaded connections above
3 during the impact of the key of the locating tool
4 against the groove, and each has a predetermined width
5 $5w$ and profile. In the system of the invention shown
6 in Figs. 3, 4 and 5, a locating tool 7 is mounted on a
7 whipstock 10 at the lower end of a work string (not
8 shown). A spring loaded key 15 is carried on the
9 locating tool 7, and comprises a laterally extending
10 boss of a predetermined size to fit within the width $5w$
11 of the spiral groove 5. The spring loaded key 15 is
12 received within a recess in the locating tool and is
13 sprung laterally so that it abuts against the inner
14 face of the casing 1 in normal operation of the tool.

15
16 In use, the whipstock 10 and locating tool 7 are
17 inserted into a casing string by a conventional work
18 string etc (not shown) until the boss on the spring
19 loaded key 15 engages the slot 5 in the casing 1. When
20 the boss is located in the spiral slot, the movement of
21 the whipstock 10 and locating tool 7 is restricted to a
22 downward spiral movement until the boss engages at the
23 rest location $5r$ at the end of the slot 5. The
24 whipstock is oriented in relation to the locating tool
25 such that when the boss on the key 15 is at the rest
26 location $5r$ in the slot 5, the whipstock 10 is
27 positioned to deflect a drill string (not shown) from
28 above through a window $1w$ in the casing 1.

29
30 Modifications and improvements can be incorporated
31 without departing from the scope of the invention. For
32 instance, three or more spiral grooves can be provided
33 in the casing string at different rotational and/or
34 vertical locations (ie at different depths). Different
35 spiral slots can have differing widths or profiles so
36 as to allow the engagement of only predetermined keys

1 15. By selecting the appropriate key on the locating
2 tool, the rotational and/or vertical positioning of the
3 locating tool (and hence the whipstock, or other
4 downhole tool) can be determined from the surface
5 simply by inserting the locating tool 7 and whipstock
6 10 into the casing string and delivering the assembly
7 to the appropriate depth until the key 15 engages in
8 the slot.

9
10 Where separate slots are spaced vertically from one
11 another, any one slot will preferably be of narrower
12 width or profile than the slot immediately below it, so
13 that the slot first engaged by the key on the locating
14 tool being inserted will only be engaged if the
15 profiles of the key and slot fit, and larger keys
16 intended for positioning further down the casing string
17 will not engage with narrower slots at the upper levels
18 of the casing string.

19
20 In certain embodiments (an example is shown in Fig. 5)
21 the groove 5 has a profile at the key seat to
22 facilitate self-cleaning of the groove 5. In the
23 example shown in Fig. 5, these comprise a narrower
24 portion of the groove 5n through which the key 15
25 cannot pass and/or a ramped profile 5r to prevent
26 accumulation of debris at the key seat.

27
28 It is of course possible to have different profiles or
29 widths of slot at the same vertical position, but at
30 different rotational positions, so that by engaging the
31 appropriate key into the slot, the rotational resting
32 position of the locating tool can be specified even if
33 the depth is not altered.
34

1 **CLAIMS**

2

3 1. A wellbore system for selectively locating a
4 downhole tool in a wellbore casing or tubing comprising
5 a plurality of positioning guides spaced in the
6 wellbore casing or tubing at predetermined depths
7 wherein each positioning guide has a unique profile for
8 selectively receiving a matching profile key of a
9 downhole tool, the guide for each key having a
10 configuration which controls the depth and rotational
11 position of its matching key.

12

13 2. The wellbore system according to Claim 1, wherein
14 the positioning guides are slots or ledges which
15 extends downwardly and laterally.

16

17 3. The wellbore system according to any preceding
18 claim, wherein each positioning guide is spiral-shaped.

19

20 4. A wellbore system according to any preceding
21 claim, wherein each positioning guide spirals around a
22 minimum of 450° of circumference.

23

24 5. A wellbore system according to any preceding
25 claim, wherein the keys are spring loaded, extendable
26 and/or retractable.

27

28 6. A wellbore system according to any preceding
29 claim, wherein each positioning guide is a slot with a
30 unique width for selectively receiving a matching key
31 of substantially the same width.

32

33 7. A wellbore system according to any preceding
34 claim, wherein the downhole tool is a whipstock.

35

36 8. A wellbore system according to any preceding

1 claim, wherein the downhole tool is a running tool.

2
3 9. A method of selectively locating a downhole tool
4 in a wellbore casing or tubing comprising the steps of:

- 5
6 a) placing a plurality of positioning guides at
7 desired depths in the wellbore casing or tubing
8 wherein each guide has a unique profile for
9 selectively receiving a matching profile locating
10 key,
11 b) selecting the profile of a locating key for the
12 downhole tool to match the profile of a desired
13 positioning guide, and
14 c) running the downhole tool to the desired
15 positioning guide wherein the locating key engages
16 the matching profile of the positioning guide
17 which controls the depth and rotational position
18 of the locating key to orient the downhole tool in
19 a desired direction.

20
21 10. The method of Claim 9, wherein the positioning
22 guides are slots or ledges which extend downwardly and
23 laterally.

24
25 11. The method according to Claims 9 or 10, wherein
26 each positioning guide is spiral-shaped.

27
28 12. The method according to any one of Claims 9 to 11,
29 wherein each positioning guide spirals around a minimum
30 of about 450° of circumference.

31
32 13. The method of any one of Claims 9 to 12, wherein
33 the locating key is spring loaded and/or retractable.

34
35 14. The method according to any of Claims 9 to 13,
36 wherein the downhole tool is a whipstock.

1 15. The method according to any one of Claims 9 to 13,
2 wherein the downhole tool is a running tool.

3

4 16. The method according to any one of Claims 9 to 13,
5 wherein a second downhole tool with a different
6 profiled locating key is located in a second
7 positioning guide above the first positioning guide.

8

9 17. The method according to any one of Claims 9 to 16,
10 wherein each positioning guide is a slot with a unique
11 width for selectively receiving a matching key of
12 substantially the same width.

13

14 18. A wellbore system as hereinbefore described with
15 reference to any one of Figs. 3 to 5 of the
16 accompanying drawings.

17

18 19. A method of selectively locating a downhole tool
19 in a wellbore casing or tubing as hereinbefore
20 described.



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Claims searched: 1-19

Examiner: J. C. Cowen
Date of search: 3 March 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): EIF FAU, FCU, FCX, FGU, FKB, FKC, FKG, FKU

Int Cl (Ed.6): E21B 23/00, 23/01

Other: WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2,138,867 (Ava International Cooperation)	1,5,13
A	GB 2,302,109 (Baroid Technology Inc)	1

X Document indicating lack of novelty or inventive step
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